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When to Harvest Sweet Cherries Mechanically

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By J. H. LEVIN, R. T. WHITTENBERGER and H. P. GASTON[2]

MICHIGAN SWEET CHERRY growers harvested about 5 million pounds with machines in 1968. Mechanical harvesting will increase rapidly because of difficulties in recruiting hand pickers and monetary savings.

"When to harvest" is a major decision which must be made by growers who harvest mechanically and who hand pick. Growers harvest sweet cherries as early as possible to get the crop off before tart cherry harvesting starts. Growers also start early to reduce losses due to cracking, wind whip or decay.

Many growers may be harvesting their sweet cherry crop too early. There is a time when mechanical harvesting will remove the greatest tonnage of salable cherries.

Research (1965-67) showed that cherry size and weight increased during the harvest season without a substantial increase in decay and rot. This study was made in July, 1968 to determine the optimum time for harvesting sweet cherries.

What Was Done

During a period one week before to one week after normal harvesting, the following items were measured:

(1) size of fruit
(2) weight of fruit
(3) soluble solids content of fruit
(4) pull forces required to remove cherries from stems and stems from branches
(5) percent of fruit removed from tree by standard mechanical shaking technique
(6) percent rot, wind whip and scars on fruit
(7) percent cracking of fruit
(8) loss of fruit to birds and/or onto ground
(9) quality of harvested fruit

How It Was Done

In the Lake Leelanau area of northwest lower Michigan, measurements were made twice a week for 3 weeks on the cherries produced by three Schmidt, three Windsor, and three Napoleon variety trees. The medium size trees produced from 90 to 140 pounds of fruit. Tests were made as follows:

1) Pull forces required to remove 40 cherries without stems from each tree were measured with a special spring gauge. Ten each were from the north, east, south and west sides of the tree (Fig. 1).

2) Pull forces required to remove 20 cherries with stems from each tree were determined. Five were from the north, east, south and west sides of the tree.

Fig. 1. The force to detach cherries was measured periodically during the season.

[1]Based on work carried out jointly by the Fruit and Vegetable Harvesting Section, Agricultural Engineering Research Division, and the Eastern Utlization Laboratory, USDA; and Departments of Horticulture and Agricultural Engineering, Michigan State University.

[2]Leader, Fruit and Vegetable Harvesting Investigations, Agr. Eng. Research Div., USDA, E. Lansing, Mich. 48823; Reasearch Chemist, Eastern Utlization Res. & Dev. Div., USDA, Phila., Pa. 19118; and Asst. Professor, emeritus, Dept. of Horticulture, Michigan State University, E. Lansing, Mich. 48823, respectively.

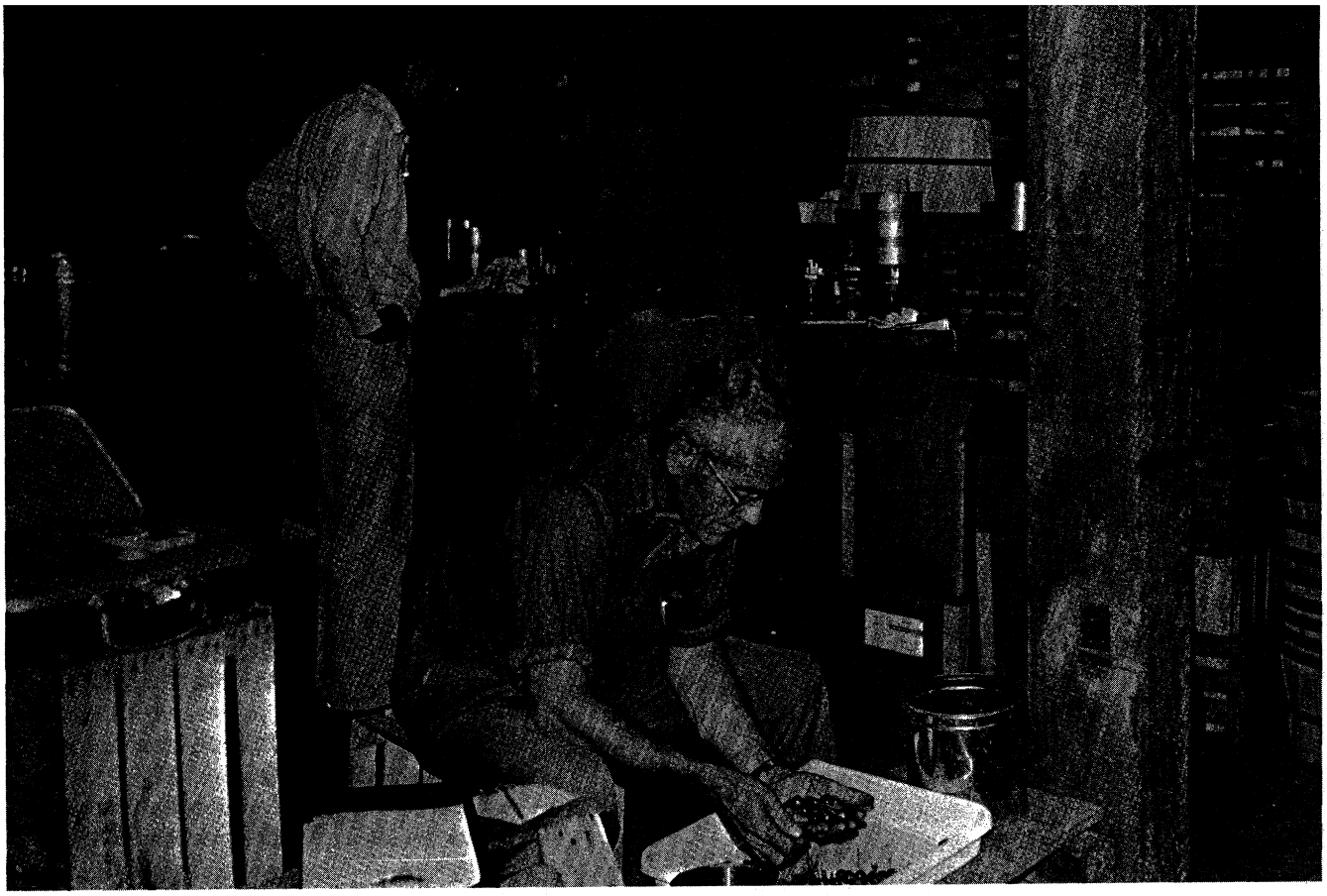

Fig. 2. Soluble solids, cherry weight, percent defects and cracks, and grade were determined twice a week for a 4-week period.

3) The average cherry weight for each tree was determined (Fig. 2).

4) Average soluble solids contents of cherries from each tree were determined (Fig. 2).

5) Two limbs on each tree were marked and the number of cherries on each limb was counted (about 200 cherries per limb). Data was obtained at each test period on the number of cherries cracked, decayed, wind-whipped and lost to birds or drop.

6) Ten cherries on each limb were marked and their diameters measured with calipers.

7) On selected days beginning July 16 a near-by tree of each variety was harvested mechanically. Cherries remaining on the trees were hand picked and percentages of recovery determined (Fig. 3). The mechanically harvested cherries were evaluated for attached stems, bruise damage, cracks, decay, wind-whip, weight and soluble solids.

8) Finally, the test trees were harvested mechanically and the cherries evaluated as in item (7) above.

Size of Cherry

Fig. 4 shows the changes in diameter of sweet cherries from July 8 to 28. At all harvest dates, Napoleon cherries were largest, and Windsor cherries were smallest. All 3 varieties increased rapidly in size from July 8 to July 18, and leveled off. Napoleon cherries increased in diameter from 0.775 to 0.875 inches (13 percent), Schmidt cherries from 0.740 to 0.850 inches (15 percent), and Windsor cherries from 0.720 to 0.835 inches (16 percent).

Commercial hand harvesting began July 12 and mechanical harvesting July 14; harvesting by both methods ended July 20. If harvest had been delayed one week this season, growers would have profited from increases in cherry size of 10 to 12 percent. Michigan processors would have received a higher proportion of large cherries needed for the maraschino cocktail pack.

Fig. 3. Determining the recovery of sweet cherries during mechanical harvest.

Measurable differences in size were not observed among cherries growing on the north, south, east or west sides of the trees.

Soluble Solids of Fruit

Changes in soluble solids content of Napoleon, Schmidt, and Windsor cherries July 8 to 28 are shown in Fig. 5. At all harvest dates, Schmidt cherries had the highest soluble solids, and Windsor cherries the lowest. The increases in soluble solids during the 20-day test period were: Schmidt cherries, 15.0–19.8 percent (32 percent increase); Napoleon cherries, 13.0–17.0 percent (31 percent increase); and Windsor cherries, 12.5–15.8 percent (26 percent increase). Soluble solids of all varieties tended to level off about July 26.

Cherry Weight

The increases in weight of Napoleon, Schmidt, and Windsor cherries from July 8 to 26 are shown in Fig. 6. Napoleon cherries were the heaviest and Windsor cherries the lightest at all harvest dates. On July 8 the average Napoleon cherry weighed 4.35 grams. Weight increases of 23 and 34 percent were recorded on July 18 and July 24, respectively. Corresponding increases for the Windsor variety were 41 and 61 percent. On July 24, average cherry weights were: Napoleon, 5.80 grams; Schmidt, 5.50 grams; and Windsor, 5.15 grams.

The weight figures correlate closely with the size and soluble solids data. The weight of a cherry is its volume times its density. Since volume is a function of the diameter cubed, a change in diameter from 0.7 inch to 0.8 inch would result in a 50 percent increase in volume or weight.

Delaying harvest one week would have increased cherry tonnage by 25 percent. This means that a grower who harvested 100 tons of cherries July 12-18 would have harvested 125 tons if he had harvested July 16-22. Since sweet cherries were worth approximately $300 per ton, the increased tonnage would have meant a gain in gross income of $7,500, providing there were no increases in losses from cracking or decay. Changes in quality of the cherries are described in a later section of this paper.

Pull Forces (Removal Forces)

The force required to remove a cherry from its stem (pull force) is an indication of whether the cherry can be detached by shaking the tree. When a tree is shaken, the cherry is accelerated. If the acceleration force is greater than the pull force, the cherry will be detached. Since acceleration equals force divided by mass, mass (weight of individual fruit), as well as pull force, affects detachment. An

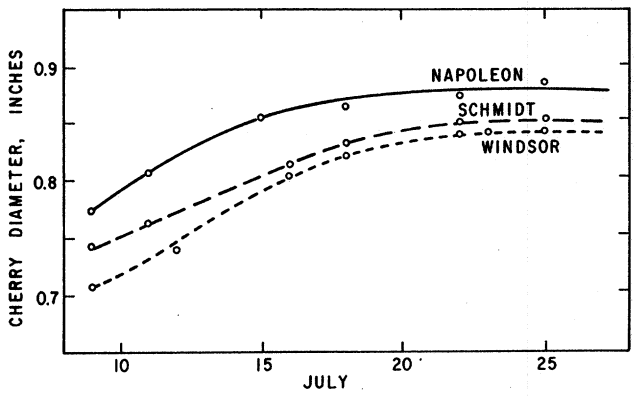

Fig. 4. Changes in diameter of sweet cherries during growth.

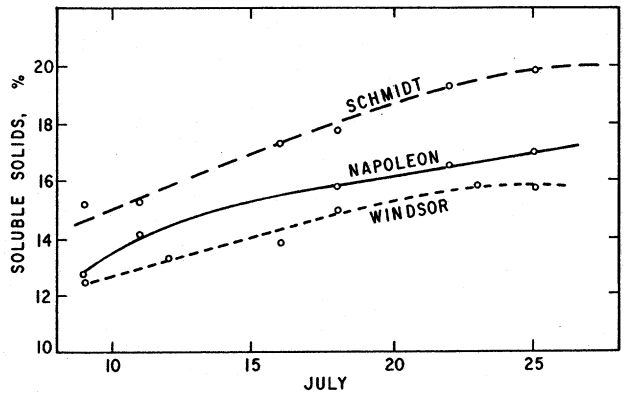

Fig. 5. Changes in soluble solids content of sweet cherries during growth.

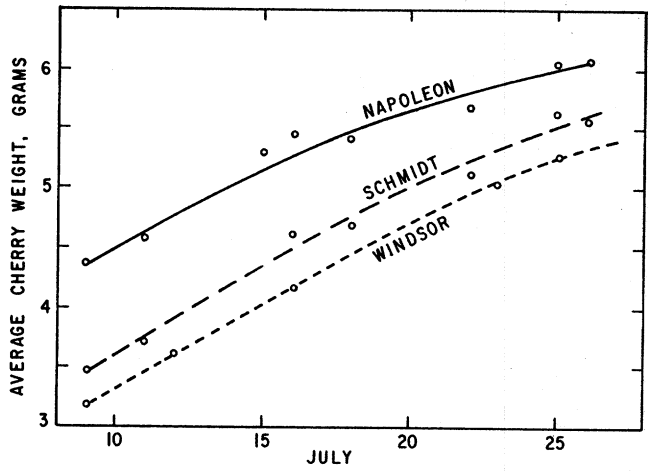

Fig. 6. Changes in weight of sweet cherries during growth.

increased percentage of cherries will be detached for any given vibration (shake) when cherries are large and pull forces are small.

Pull forces should be under 500 grams for quick removal. Cherries can be detached after several shaking cycles with forces of 650 grams. Pull forces of 300 grams or less, and shaking periods of 1 or 2 cycles, are desirable since these conditions give minimum bruise damage. Progress is being made in developing chemicals that loosen cherries and reduce pull forces.

Changes in pull forces of Napoleon, Schmidt, and Windsor cherries from July 8 to 28 are shown in Fig. 7. Napoleon cherries had the highest pull forces and Windsor cherries the lowest. For all 3 varieties the pull forces decreased substantially between July 8 and 22, and leveled off. For example, on July 8 pull forces for all 3 varieties were over 1000 grams. During the next 14 days pull forces dropped to the following values: Napoleon, 450 grams; Schmidt, 375 grams; and Windsor, 360 grams. The values remained constant after July 22.

Data indicate that the percentage of cherries recoverable by mechanical harvesting increased until about July 22, 1968. After that date the increases were small and maximum recoveries probably would not exceed about 95 percent.

With Napoleon cherries, average pull forces did not decrease to 650 grams until July 16. The corresponding date for Schmidt and Windsor cherries was July 14. Thus, relatively low recoveries from mechanical harvesting could be expected before these dates. In actual practice in 1968, some growers attempted to harvest before July 14, but halted operations because of low recoveries, high stem counts, and excessive bruising.

Pull forces did not fall to 500 grams until the following dates: Napoleon, July 19; Schmidt, July 18; and Windsor, July 17. On these and subsequent dates, recoveries from mechanical harvesting should approximate 90 to 95 percent.

At any one date, the percent recovery from mechanical harvesting can be predicted by determining the percentage of pull force readings that are less than 650 grams. For instance, on July 15, 48 percent of the Napoleon cherries had pull forces of less than 650 grams. On July 18 and July 22, the values were 83 and 97 percent, respectively. These values correlate well with the actual percentages of recovery obtained during mechanical harvest on corresponding dates.

Attached Stems

Pull forces needed to remove cherries with stems attached remained high at all harvest dates. The majority of the readings were about 1000 grams. However, at all dates some readings for each variety were less than 650 grams. Some cherries with stems attached would be harvested by the machines at all dates. Since the pull forces required to remove cherries without stems decreases, the proportion of stemless cherries in the harvest should increase as the season advances. The Windsor variety had both the lowest number of cherries with pull forces under 650 grams, and the highest percentage of fruit with attached stems after harvest.

In some cases cherries on the east and south sides of the trees had smaller pull forces than those on the north and west sides. However the differences were not significant.

During 1968 some Michigan processors experienced difficulty in removing stems from Schmidt cherries with the rotating blade destemmer. The difficulty was overcome by delaying harvest and permitting stem pull forces to weaken.

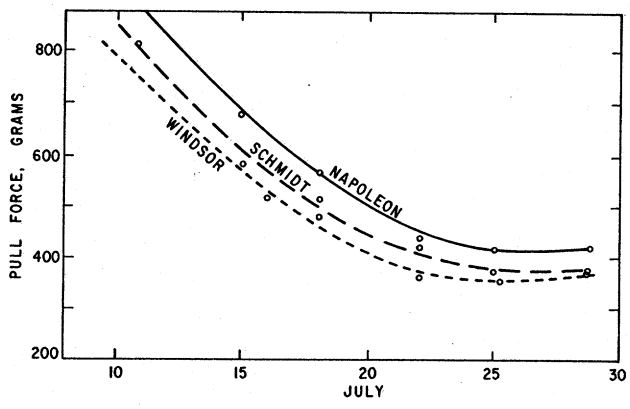

Fig. 7. Changes in stem pull forces of sweet cherries during growth.

Mechanical Harvesting

Recovery of fruit increased and the proportion of attached stems decreased as the date of mechanical harvest was delayed. For example, recoveries of Windsor cherries on July 16, 19, 23, and 26 were 83, 87, 92, and 97 percent respectively. Corresponding values for attached stems were 90, 81, 71, and 26 percent.

Similar data were obtained with Napoleon and Schmidt cherries. Recovery of Napoleon cherries increased from 90 percent on July 16 to 96 percent on July 26. At the same time, attached stem counts dropped from 67 to 28 percent.

The results indicate that if mechanical harvest had been delayed for one week after the normal harvest period started, recovery of fruit would have increased by 4 to 5 percent. The tonnage of fruit would have increased by 25 percent.

Rot, Wind Whip and Scars

The incidence of rot, wind whip and scars was small during the study. No increases were noted with Napoleon cherries, and no increases occurred with Schmidt and Windsor varieties until about July 25 when a 2 percent increase was observed with both varieties. Scars and decay are caused by weather conditions such as high wind, high humidity, and rain.

In 1968, weather conditions were not conducive to decay. In another year these figures might be higher. However, growers can afford to gamble on losing a small percentage of fruit when increases of 25 percent in tonnage and 5 percent in recovery are likely to be obtained.

Cracked Cherries

The 3 varieties showed marked differences in the extent of fruit cracking. Almost no cracking (less than 2 percent) occurred with the Schmidt variety during the entire span of the experiment. The greatest tendency to crack was shown by the Windsor cherries, although in 1968 the total amount of cracking (5-8 percent) was relatively small. The cracking occurred mostly July 19-22 following several days of rains. No additional cracking occurred as harvest was delayed several days. The Napoleon cherries exhibited an intermediate amount of cracking. During July 19-22, the extent of cracking rose from 1 to 5 percent and leveled off.

Exactly what causes sweet cherries to crack is not known. A study is now underway by the USDA and MSU to determine the causes and nature of cracking.

Loss to Birds and/or Dropping on the Ground

Initially there were about 3,600 cherries on the 18 test limbs of the 9 trees. Less than 1 percent of the fruit was lost to birds and/or to dropping on the ground. In some orchards, birds can be a problem—but this was not true in the orchard where the experiments were conducted.

Quality of Fruit

Mechanically harvested cherries were graded at the processing plant. Data on attached stems, decay, wind whip, and cracks checked closely with those obtained from the limb studies.

Very little bruise damage occurred during mechanical harvest until about July 26. At that time 7.5 percent of the Windsor cherries and 5.5 percent of the Napoleon cherries became crushed or split during harvest. In contrast, Schmidt cherries were particularly resistant and showed only 1.8 percent damage.

Bruise damage correlated generally with the quantity of cracked cherries on the trees. A high proportion of the cracked cherries became bruised during mechanical harvest. A cracked cherry is weak structurally, lacks the protection given by an intact skin and is susceptible to damage. Susceptibility increases as the cherry matures and enlarges. Increased bruise damage can be expected with some varieties if harvest is delayed too long.

CONCLUSIONS

1. During the period July 8-28, 1968 (a) fruit size increased about 15 percent; (b) soluble solids of all varieties increased about 30 percent; (c) weight of cherries increased 34 percent for Napoleon, 57 percent for Schmidt and 61 percent for Windsor.
2. Pull forces required to remove cherries from their stems decreased from over 1000 grams to about 400 grams during the 20-day period.
3. The forces required to detach stems from branches did not decrease substantially during this period.
4. Mechanical harvesting data showed that recovery of fruit increased from less than 50 to more than 90 percent during July 8 - 28. Attached stems dropped from more than 90 to about 25 percent.
5. Decay and scarring did not increase significantly during the 20-day period.
6. Extent of cracking remained small (about 1 percent) until July 20, when the Windsor and Napoleon varieties showed increases of a few percent. No further cracking occurred. Cracking of Schmidt cherries remained less than 2 percent at all times.
7. Bruise damage during mechanical harvest was very small until about July 26 when 8 percent of the Windsor, 6 percent of the Napoleon, and 2 percent of the Schmidt cherries became crushed or split. Damage correlated with the quantity of cracked cherries on the trees.
8. Delaying the harvest of Napoleon, Windsor, and Schmidt cherries 5-7 days in 1968, until they were more mature, increased the tonnage of fruit and its recovery during mechanical harvest 25-35 percent. The cost in quality for the increased tonnage and recovery was small. Many Michigan growers of sweet cherries could obtain increased profits by delaying the harvest.